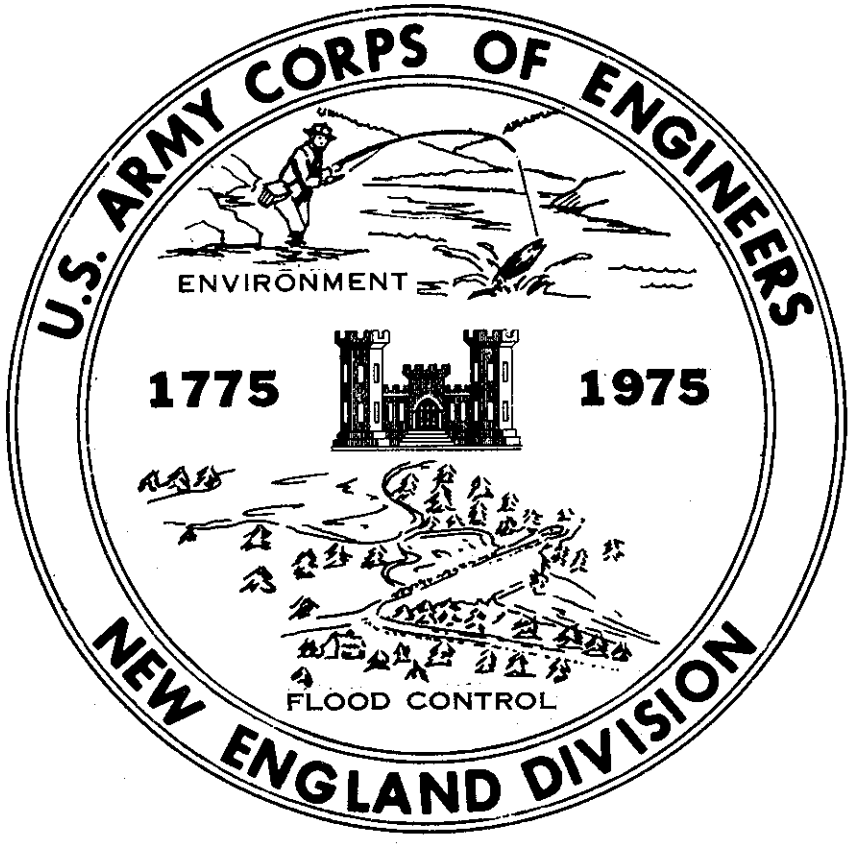
# FLOOD PLAIN INFORMATION

## SAUGUS and MILL RIVERS
## WAKEFIELD, MASSACHUSETTS




AUGUST 1975

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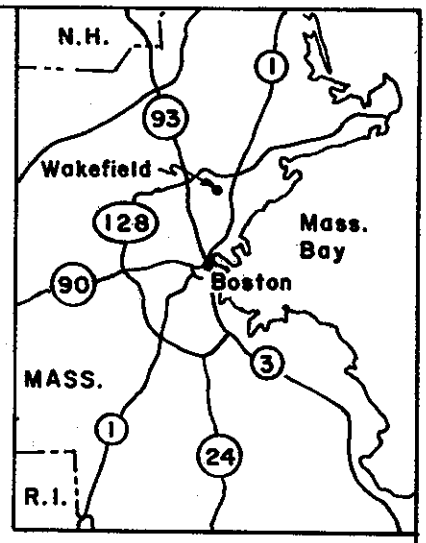


VICINITY MAP
Scale in Miles
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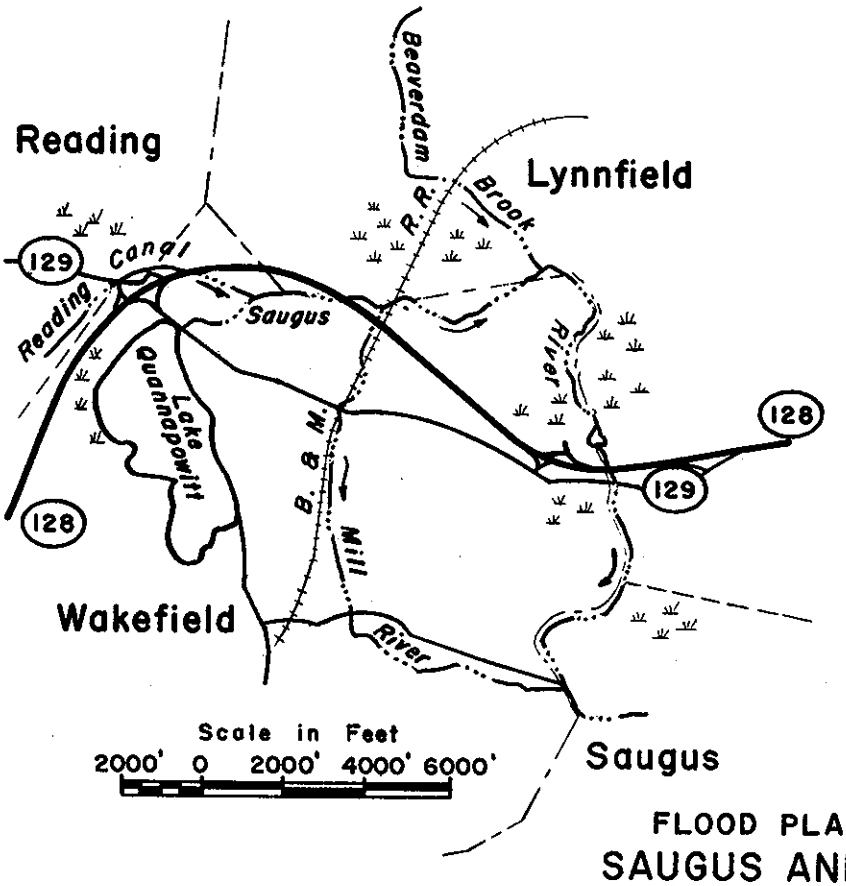



Scale in Feet
2000' 0 2000' 4000' 6000'

FLOOD PLAIN INFORMATION
# SAUGUS AND MILL RIVERS
# WAKEFIELD, MASSACHUSETTS
# GENERAL MAP
AUGUST, 1975

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. 1

# PREFACE

The information presented in this report relates to the flooding along the Saugus and Mill Rivers through Wakefield, Massachusetts. River reaches considered under this study are: (a) the Saugus River from Lake Quannapowitt to the Saugus Town Line, a distance of 4.5 miles and (b) the Mill River from Lowell Street to the Saugus River, a distance of 2.2 miles.

This report has been prepared because a knowledge of flood potential and flood hazards is important in land use planning and for management decisions concerning flood plain utilization. It includes a history of flooding in Wakefield and identifies those areas that are subject to future floods. Special emphasis is given to these floods through maps, photographs and profiles. The report does not provide solutions to flood problems; however, it does furnish a suitable basis for the adoption of land use controls to guide flood plain development and thereby prevent intensification of the loss problems. It will also aid in the identification of other flood damage reduction techniques, such as works to modify flooding and adjustments, including flood proofing, which might be embodied in an overall Flood Plain Management (FPM) program. Other FPM program studies - those of environmental attributes and the current and future land use roles of the flood plain as part of its surroundings - would also profit from this information.

At the request of the Town of Wakefield and with the endorsement of the Massachusetts Water Resources Commission, this report was prepared by Green Engineering Affiliates, Inc., for the Corps of Engineers, New England Division, under continuing authority provided in Section 206 of the 1960 Flood Control Act, as amended.

Assistance and cooperation of the U.S. Geological Survey, the Town of Wakefield, State Agencies, private firms and citizens in supplying useful data for the preparation of this report are appreciated.

Additional copies of this report can be obtained from the Town of Wakefield. The Corps of Engineers, New England Division, upon request will provide technical assistance to planning agencies in the interpretation and use of the data presented as well as planning guidance and future assistance, including the development of additional technical information.

# BACKGROUND INFORMATION

## Settlement

The history of settlement in Wakefield goes back to 1639, when residents of Lynn petitioned the General Court of the Massachusetts Bay Colony "for an inland plantation at the head of their bounds". By 1644 there were seven homes built around the Wakefield Common in this plantation area, enough population for the General Court to incorporate the community as the Town of Reading. As first incorporated, the Town of Reading included what is now Reading and Wakefield. In 1651, what is now North Reading was added to the Town, and in 1727 Reading absorbed what is now known as Greenwood. The economy of the Town during this early period centered on farming, augmented by sawmills and gristmills, which were situated on the banks of the rivers and run on water power. Shoemaking, carried on for the most part in small home shops, was probably the Town's first industry.

What is now Wakefield was separated from the original Town of Reading in 1812 because of political conflict among the three sections of the community. The Wakefield section (First Parish) were Democratic Republicans whereas, the North Reading (Second Parish) and Reading (Third Parish) sections were Federalists. The disagreement came to a head during the War of 1812, when the pro-war First Parish, which was in power at the time, received a charter for the new Town of South Reading.

The Town grew slowly until in 1845 the Boston and Maine Railroad line between Boston and Wilmington (passing through Wakefield) was completed, causing the Town's first period of rapid growth. The railroad connection made Wakefield a residential suburb of Boston and somewhat of an industrial center in its own right. Industries started in the Town because of the railroad include a rattan furniture and jute matting factory, the Boston and Maine foundry which manufactured stoves and plumbing supplies, and some ice companies which cut and stored ice from the lakes and shipped it south. In 1862, the shoe industry was transformed by the introduction of shoe machinery. Toward the end of the nineteenth century, a large knitting mill and a piano factory were started. The Town's name was officially changed to Wakefield in 1868 after Cyrus Wakefield, who owned the rattan furniture factory and who financed construction of the new Town Hall, which was completed in 1871.

Wakefield's second spurt of growth was occasioned by the introduction of trolley service from Boston through Melrose at the turn of the century. The provision of this cheap form of transportation caused an increase in population and residential development. The Depression brought a temporary halt to this population growth, and the period which followed brought a diversification of industries. Electronic industries became important to the Town of Wakefield as they are to the entire Boston Standard Metropolitan Statistical Area. The construction of Route 128, like the completion of the railroad in the

nineteenth century, created accessible sites for the location of new business and industries. These factors contributed towards the industrial, business and residential developments of the town during the past two decades. The growth has slowed down in recent years, indicating that the Town has reached its saturation point.

The Streams and Their Valleys

The Saugus River originates at the outlet of Lake Quannapowitt in the northern part of Wakefield, Massachusetts, and flows in a general easterly direction, is joined by the Reading Drainage Canal and forms the Town boundary between Wakefield and Lynnfield. It then flows east and south through a large storage reach north of Route 128 to the Lynn waterworks diversion, then south until it crosses the Saugus Town line just northwest of the Breakheart Reservation. It has a total drainage area at the Wakefield-Saugus Town line of 15.7 square miles and a total fall of 31 feet.

Lake Quannapowitt, with a surface area of 250 acres has surcharge storage capacity equivalent to 5 to 6 inches of runoff from its contributing watershed of 1.6 square miles. An area of 3.2 square miles northwest of the lake which formerly drained into the lake is now drained by the Reading Canal. The canal is not designed to carry large floodflows. The northern part of the watershed is characterized by large swamps and undeveloped areas. The Saugus River, with an average slope of 7 feet per mile, and a relatively flat watershed would be classified a hydraulically sluggish river.

The Mill River rises in the northern part of Wakefield and flows south and then east for a total distance of 2.5 miles to its mouth on the Saugus River just downstream of Water Street near the Wakefield-Saugus Town line. It has a total drainage area of 3.6 square miles and a total fall of 22 feet.

## Development in the Flood Plain

### Saugus River

The flood plain of the Saugus River covered in this report can be divided into three areas:

1. The area between the Outlet of Lake Quannapowitt and The Route 128 crossing just downstream of Vernon Street is essentially residential. The middle portion of this area has a relatively wide floodplain with a well defined river bed.
2. The area between the above Route 128 Crossing and a second crossing of Route 128, downsteam from the Colonial Golf and Country Club, is more industrial with an extensive area along the downstream crossing of Route 128 subject to flooding. This area has an extremely wide flood plain with a relatively well defined river bed.
3. The area between the second crossing of Route 128 and the Wakefield - Saugus Town Line, downstream from the Mill River confluence, is essentially residential with a relatively narrow flood plain and well defined river bed.

Mill River

The flood plain of the Mill River is generally narrow with a relatively well defined river bed. Throughout its entirety the river has a mixture of residential and industrial developments along its flood plain.

Both the Saugus and Mill Rivers experience flooding during heavy rains because of backwater produced by inadequate channel dimensions and undersized culverts and bridge openings. In general, most of the flood losses in the areas considered in this report, are caused by high water tables and seepage into cellars, with a relatively small percentage of losses caused by overland flooding.

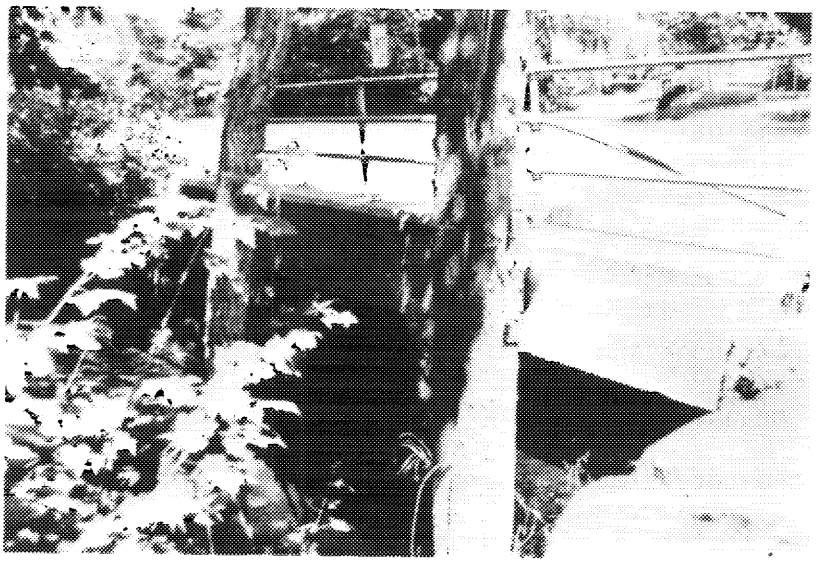


FIGURE 1 - LOWELL STREET BRIDGE - SAUGUS RIVER
RIVER MILE 1.54

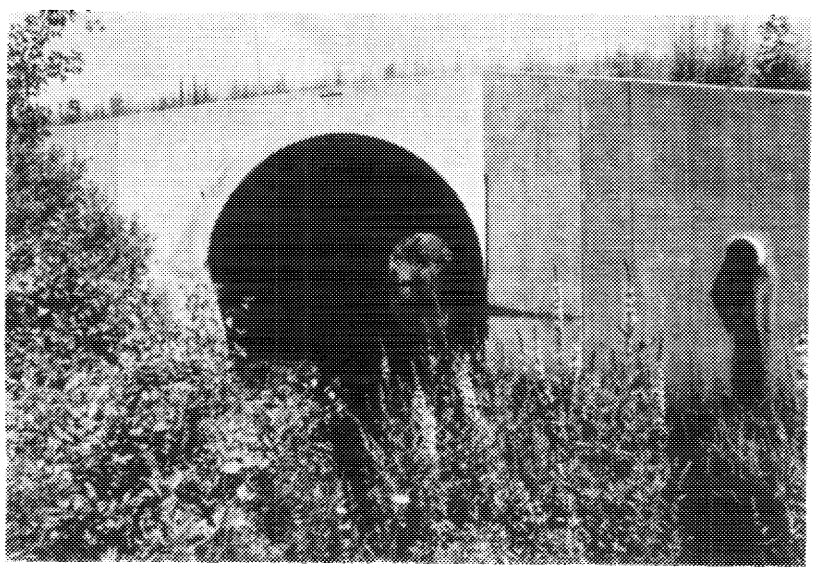


FIGURE 2 - ROUTE 128 BRIDGE UPSTREAM FROM LOWELL STREET - SAUGUS RIVER
RIVER MILE 1.63

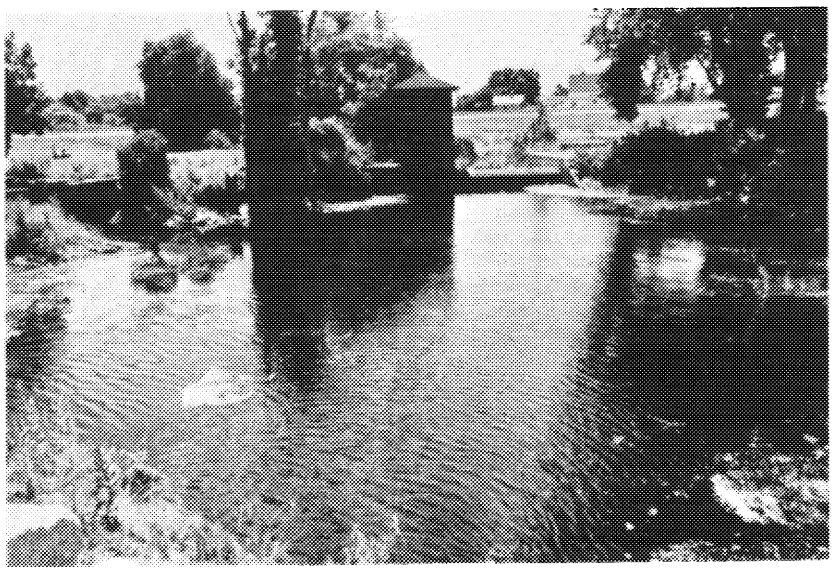


FIGURE 3 - SAUGUS RIVER DAM - SAUGUS RIVER
RIVER MILE 1.71

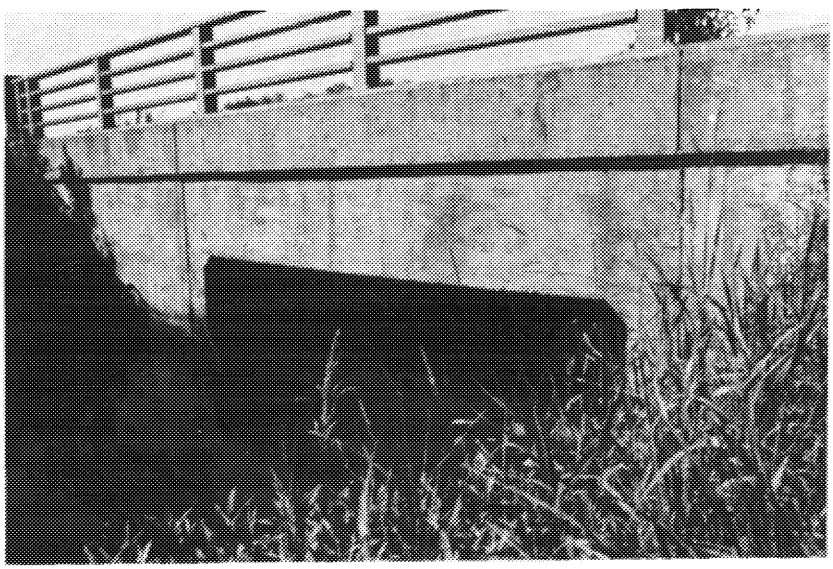


FIGURE 4 - ROUTE 128 BRIDGE DOWNSTREAM FROM VERNON STREET - SAUGUS RIVER
RIVER MILE 4.09

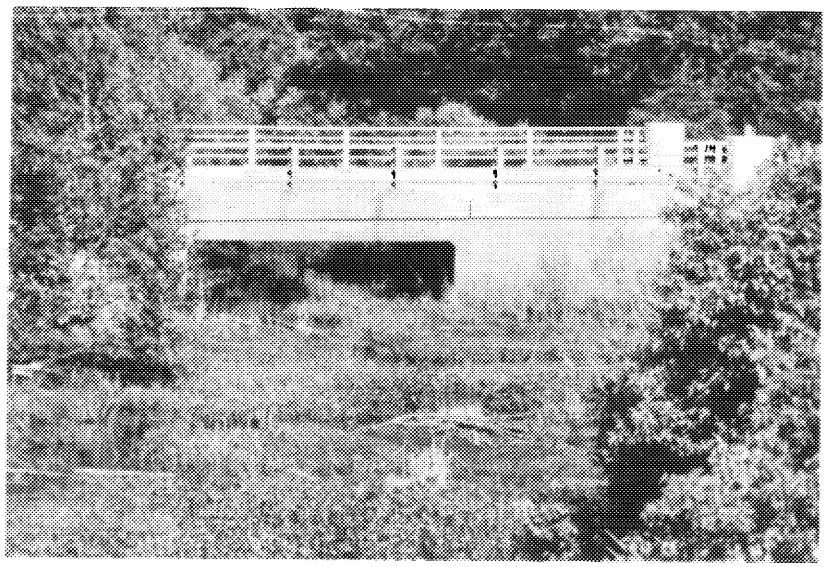


FIGURE 5 - VERNON STREET BRIDGE - SAUGUS RIVER
RIVER MILE 4.16

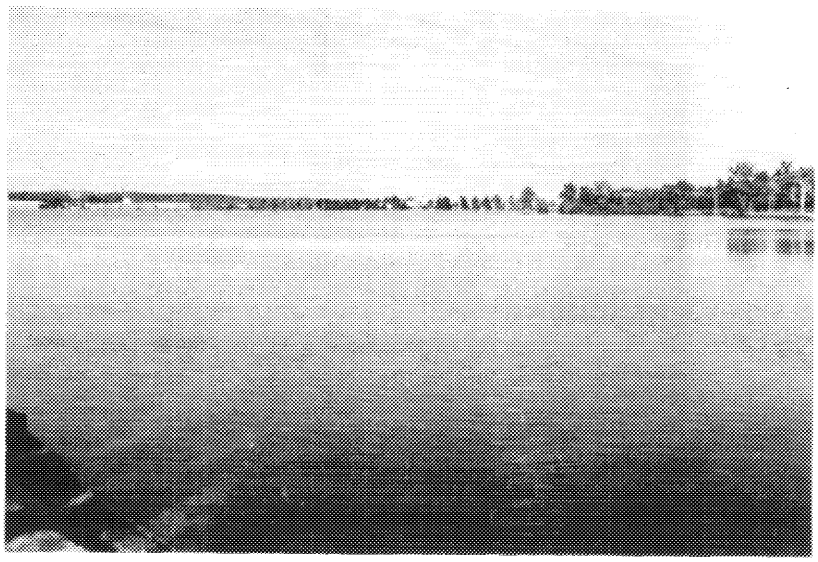


FIGURE 6 - QUANNAPOWITT LAKE

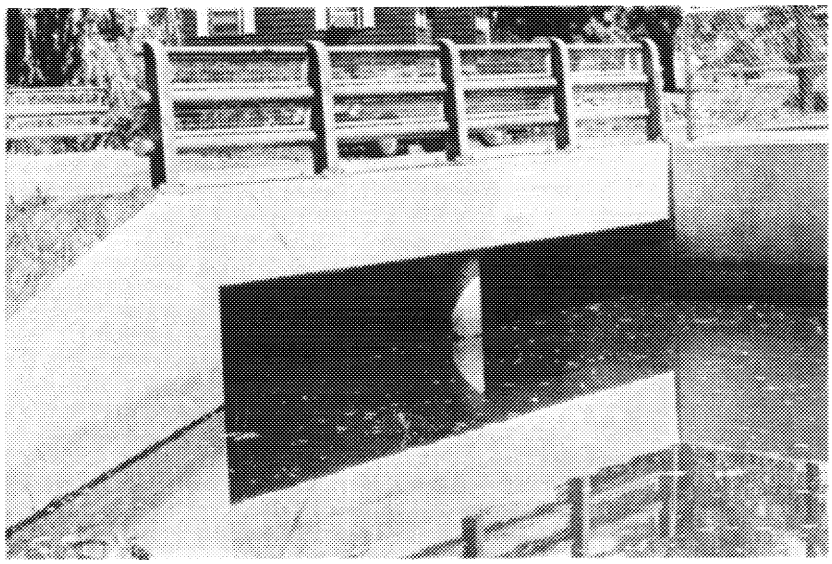


FIGURE 7 - WILEY STREET BRIDGE - MILL RIVER
RIVER MILE 0.26

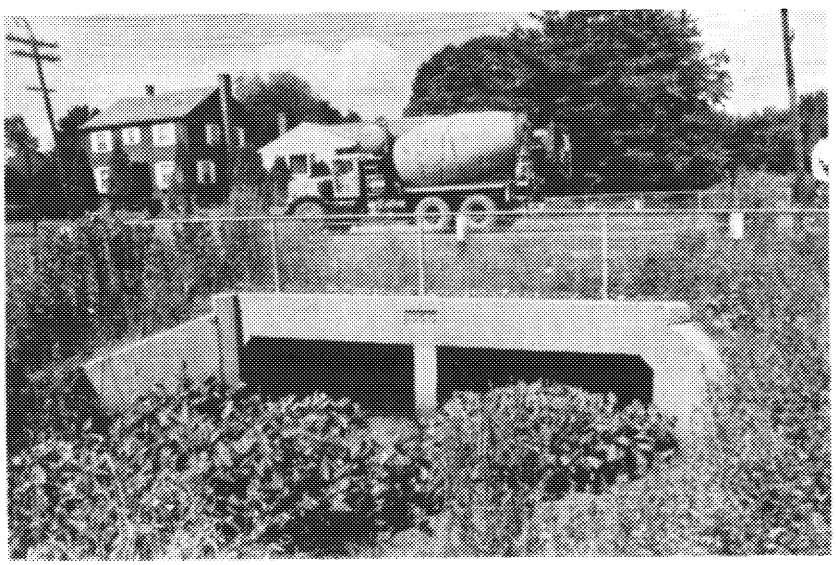


FIGURE 8 - FARM STREET BRIDGE - MILL RIVER
RIVER MILE 0.49

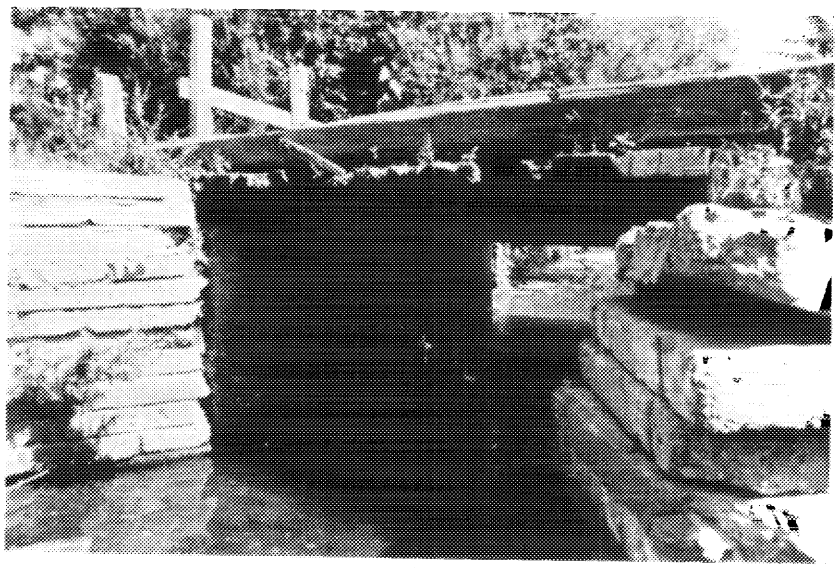


FIGURE 9 - VINTON STREET BRIDGE - MILL RIVER
RIVER MILE 1.15

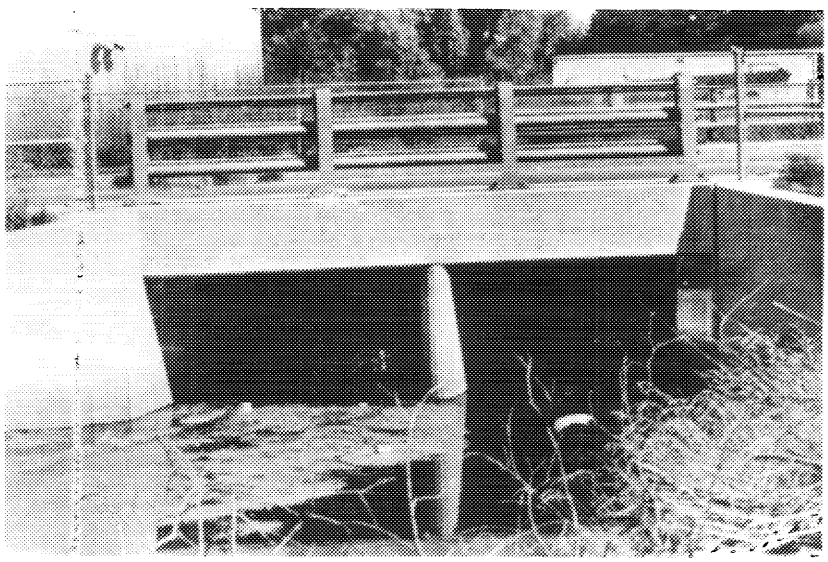


FIGURE 10 - WATER STREET BRIDGE - MILL RIVER
RIVER MILE 1.22

## FLOOD SITUATION

### Sources of Data and Records

The highest known flood in the Saugus Mill River basin occurred in October 1962. This resulted from unprecedented rainfall varying from 10 inches to a maximum of 14 inches near the Wakefield-Saugus Town line. High watermarks for this flood, the March 1936 and March 1968 events were established by field interviews and surveys. Approximate profiles of these floods were presented in: "Report on Flood Control and Navigation, Saugus and Pines River Basin", dated June 1970. There are no discharge records for the Saugus and Mill Rivers. The nearest U.S. Geological Survey stream gaging station is located on the Aberjona River at Winchester, a hydraulically similar river located to the west of the Saugus River. The Aberjona River has an average slope of 0.002 as compared with slopes of 0.0013 and 0.0016 on the Saugus and Mill Rivers, respectively. The Aberjona River at Winchester with a drainage area of 23.3 square miles, has a 30-year period of record. Discharge frequencies for this gage were derived in a recently completed regional study and were utilized in deriving discharge frequencies for the Saugus and Mill Rivers.

The 100-year discharge for each location was first determined on an individual basis and then discharges for other frequencies were derived by ratios to the 100-year discharge established for the Aberjona River.

The 100-year discharge for the outlet of Lake Quannapowitt is based on 1.7 feet of surcharge over a 6-foot long timber weir. This rise of 1.7 feet in the lake level represents storage equivalent to 5 to 6 inches of runoff from the contributing discharge to downstream flows from the total drainage area of 1.6 square miles.

Crystal Lake, in Wakefield, is located in the headwaters of the Mill River and has a total watershed of 1.25 square miles. The lake is used for public water supply and is capable of storing significant runoff from its drainage area. A 100-year discharge of 30 cfs was adopted as the maximum outlet capacity assuming a 2-foot rise in the lake level.

Discharges for the Reading drainage canal, Saugus and Mill Rivers were based on the 100-year discharge for the Aberjona River, multiplied by a ratio of the net drainage areas to the .7 exponential power, and then adding the contributions from Lake Quannapowitt and Crystal Lake where appropriate.

Estimated discharge frequencies for the Saugus and Mill Rivers at five locations, (a) the outlet of Lake Quannapowitt, (b) the Reading Drainage Canal - upstream of the Saugus River, (c) the Saugus River above the Mill River, (d) the Mill River at its mouth, and (e) the Saugus River at the Wakefield-Saugus Town line, are listed on Table 1.

TABLE 1

DISCHARGE - FREQUENCIES
SAUGUS AND MILL RIVERS
WAKEFIELD, MASSACHUSETTS

| Location | Drainage Area (sq. mi.) | Discharges 100-year (cfs) | Standard Project Flood (cfs) |
|---|---|---|---|
| Outlet of Lake Quannapowitt | 1.6 | 40 | 60 |
| Reading Drainage Canal - upstream of Saugus River | 3.2 | 330 | 500 |
| Saugus River above Mill River | 12.1 | 700 | 1050 |
| Mill River at Mouth | 3.6 | 270 | 400 |
| Saugus River at Wakefield Town line | 15.7 | 870 | 1300 |

Maps prepared for this report were based on U.S. Geological Survey quadrangle sheets entitled: Boston North, Mass. 1971 and Reading, Mass. 1966. Structural data on bridges, culverts and dams were obtained by field surveys performed by personnel from Green Engineering Affiliates, Inc.

## Flood Season and Flood Characteristics

Past records indicate that most of the notable floods in Saugus-Mill River watershed have occurred in the spring and early fall months. Occasional flooding may occur in the late summer months also.

The Saugus River watershed is subject to continually changing weather patterns characterized by frequent but generally varying periods of precipitation. The area lies in the path of the "Prevailing Westerlies" and cyclonic storms that move across the country from the west or southwest. The area is also exposed to coastal storms, some of tropical origin, that travel up the Atlantic seaboard and through or near the New England States. In the late summer and autumn months, these storms occasionally attain hurricane intensity.

## Flood Reduction Measures

A number of studies were conducted concerning flood reduction measures for the Saugus and Mill Rivers. However, no construction projects have been initiated.

## Factors Affecting Flooding and Its Impact

Obstructions to floodflows - Natural obstructions to floodflows include trees, brush and other vegetation growing along the stream banks in floodway areas. Areas where the river channel is narrow tend to raise flood levels and also contribute to the development of ice jams. Manmade encroachments on or over the streams such as dams and bridges can also create more extensive flooding than would otherwise occur.

During floods, trees, brush and other debris may be washed away and carried downstream to collect on bridges and other obstructions. As floodflow increases, masses of debris break loose and a

wall of water and debris surge downstream until another obstruction is encountered. Debris may collect against a bridge until the load exceeds its structural capacity and the bridge is destroyed. The limited capacity of obstructive bridges retard floodflows and result in flooding upstream. This increased flooding contributes to eroding around bridge approach embankments and damage to overlying roadbeds.

In general, obstructions restrict floodflows and cause overbank flooding, destruction of or damage to bridges, and an increased velocity of flow immediately downstream. It is impossible to predict the degree or location of accumulation of debris or ice at any channel obstruction in the development of the flood profiles.

Other Factors and Their Impacts - The flood problems along the Saugus and Mill Rivers are similar to those of many communities with "growing pains". Development of industrial and residential buildings and parking lots, and other construction that increase impervious surfaces have speeded up runoff and aggravated the flood problem. Very little consideration has been given to the brooks and rivers; developments have encroached on natural storage areas and floodways. For example, along the Saugus River, at about river mile 2, five industrial buildings appear to have encroached upon the flood plain. Similarly, at river miles 3 and 4, considerable residential developments are noted inside the flood limits. More industrial growth can be seen on then northeast side of Route 128 at about river mile 3.5. The abandoned amusement park at river mile 3 is being

considered for future industrial development. There has been some residential construction along the Beaverdam Brook also.

The problem of encroachment upon the natural flood plain appears to be more complex along the Mill River. Right from the confluence of the two rivers, there has been a continuous growth of residential buildings on both sides of Route 129, which itself passes through the flood plain in various places. At about river mile 0.5, an entire subdivision consisting of residential units built along a 700 foot Cul-De-Sac extends well into the flood plain. The pumping station at about river mile 1.0, the playground along the north side of Water Street, and the industrial building just north of Salem Street (river mile 1.75) are all located within the flood limit. The two industrial buildings at about river mile 1.5 also appear to have been built in the flood plain. In many sections channels have not been maintained and debris has been allowed to accumulate. These conditions which have increased the severity of the problem, promise to continue to exist in the future, although additional encroachment may be controlled by wetlands regulation and restrictive acts (see Chap. B, Sections 40 and 40A).

The Saugus River is subject to minor annual flooding caused primarily by deteriorated channels and undersized culverts. The river channel in many areas is inadequate.

The Mill River, caused more flood losses than the Saugus River

during the flood of 5-7 October, 1962. Inadequacies of the river channel and culverts caused the major problem, but backwater from the Saugus River during heavy storms also creates serious difficulties.

Flood Warning and Forecasting - The U.S. Department of Commerce, National Weather Service, is responsible for forecasting high water on the nation's rivers and for issuing flood warnings for the protection of life and property. The National Weather Service River Forecast Center at Hartford, Connecticut is responsible for issuing flood warnings for the Saugus and Mill Rivers area. A comprehensive network of rainfall and river data reporting stations have been established with cooperative observers. The flood warnings are issued by teletype simultaneously to the press services, State Police, Civil Defense and many other State and local agencies. In the event of communication failure, the State Police and Civil Defense have an emergency plan for receiving flood warnings and notifying the responsible officials.

It should be reiterated that a flood warning system is only one phase of preventative flood damage measures. The other phase is the preparation of Federal, State and local governments and private citizens to combat the impending storm. Without a sufficient storm warning and an ability to react to the warning, the residences, and industrial and commercial establishments in low-lying areas will be defenseless against the raging flood waters of the Saugus and Mill Rivers.

Flood Fighting and Emergency Evacuation Plans - There are no formal flood fighting or emergency evacuation plans for the Wakefield area. Provisions for alerting area residents and coordinating operations of City and county public service agencies in time of emergency are accomplished through the civil defense agency. This agency maintains communications with police headquarters where a radio watch is maintained 24 hours a day and the River Forecast Center's reports are received. The State Civil Defense Agency is in the process of writing a Greater Boston Community Shelter Plan which will include the Wakefield area and will assign shelter areas in case of a major disaster. Information on flood preparation or on any major disaster is disseminated through commercial broadcast stations, television, and news media and if necessary via public address systems on the police cruisers sent to the threatened areas. Responsible authorities should consider methods of fire-fighting in buildings isolated by floods which cannot be reached by conventional fire fighting equipment.

Material Storage on the Flood Plain - Streams with industrial or commercial development along the banks could have quantities of floatable materials stored on flood plain lands, such as lumber, crates, large volume containers and storage tanks and containers which may be unrestrained and buoyant. During time of floods, these floatable materials may be carried away by floodflows, causing serious damage to structures downstream and could clog bridge openings, creating more hazardous flooding problems.

## PAST FLOODS

### Summary of Historical Floods

Four floods of major proportions have been experienced on sections of the Mill and Saugus Rivers in recent years: 19 March 1936, 17-20 August 1955, 5-7 October 1962 and 20 March 1968. The maximum flood of record in the basin resulted from the storm of October 1962. Rainfall amounts varied from 10 inches to a maximum of 14 inches near the Wakefield-Saugus town line. Discharges experienced during floods are not known.

General flooding occurs on an average of once in four years on the Saugus River. Dates of significant floods in the period 1936-1968 are listed below:

| | |
|---|---|
| 19 March 1936 | 13-16 April 1961 |
| 10-13 October 1950 | 5-7 October 1962 |
| 15, 16 May 1954 | 25, 26 May 1967 |
| 17-20 August 1955 | 20 March 1968 |

### Flood Records

There are no U.S. Geological Survey gaging stations in existence on the Saugus and Mill Rivers. A gaged stream in the region with similar hydrologic characteristics is the Aberjona River. Data from the Aberjona River were used extensively in developing the hydrologic analyses for the Saugus and Mill Rivers. High water marks of past floods were obtained, residents along the stream were

interviewed, and newspaper files and historical documents were searched for information concerning past floods.

## FLOOD DESCRIPTIONS

Wakefield Daily Item

14 March 1936

"The little used Quannapowitt Blvd. was closed yesterday, because of its flooded condition, as the small culverts there could not carry away flood waters fast enough and water backed up onto the roadway. Low shoulders of the road caused swamp land on either sides of the blvd. to discharge its waters onto the road, but no inconvenience will be caused travelers, for the roadway is little used except by night parkers. North Avenue (Willow Road) has been posted north of the former Boston Ice Company."

8 October 1962

"Floods Ravage Town in worst-extended rainfall in memory - 3 days of rain resulted in an 11½" rainfall, according to a spokesman at the Broadway Pumping Station, who noted that 9½ inches fell on Saturday alone.

- Many local streets were closed by police and the DPW. These included Main Street between the Greenwood Bridge & Forest Street; Foundry and Lake Streets; New Salem Street, Water Street, Vernon Street from New Salem to Highland Streets, portions of Greenwood Street, Broadway and Wiley Street, Friend Street and Ledgewood Road and numerous other streets flooded only to hubcaps.

- The Saugus River caused most of Wakefield's flooding problems. The high water table caused water to cascade through many areas and was responsible for the closing of Water Street, Rte. 129, at the Saugus line, and also Salem Street at the Lynnfield line.
- Wakefield lost its new pumping station equipment at Farm and Water Streets where damage is expected to be about $10,000. About 1/3 of Wakefield had sewerage backing up into houses.
- Resembling a waterfall was the high cliff of ledge on Water Street, opposite Farm Street, when tons of water cascaded to the roadway. Ledgewood Road "was like a lake"; observed Sgt. Mahoney and patrolman Henry F. Galvin.
- The Academy of Our Lady of Nazareth suffered an unofficial loss of $2,000.00 when a boiler room was flooded. The Crystal Community Club on Preston Street had water that ranged in depth from 4-5'.
- Waldron Field, in the rear of the school, resembled a lake."

9 October 1962

"In Wakefield there are many, many homes with water in cellars. As fast as they are pumped they fill again. A number of householders are without heat and probably will be for another day or two, anyway. Some homeowners are living with relatives. Lake Quannapowitt spilled over 10' in front of the Lord Wakefield Hotel, but it caused no unusual flooding to the property."

## FUTURE FLOODS

Floods of the same or larger magnitude as those that have occurred in the past could occur in the future. Larger floods have been experienced in the past on streams with similar geographical and physiographical characteristics as those found in the study area. Similar combinations of rainfall and runoff which caused these floods could occur over the watersheds of the Saugus and Mill Rivers. Therefore, to determine the flooding potential of the study area, it was necessary to consider storms and floods that have occurred in regions of like topography, watershed cover and physical characteristics. Discussion of the future floods in this report is limited to those that have been designated as the Intermediate Regional Flood and the Standard Project Flood. The Standard Project Flood represents a reasonable upper limit of expected flooding in the study area. The Intermediate Regional Flood may reasonably be expected to occur more frequently although it will not be as severe as the infrequent Standard Project Flood.

### Intermediate Regional Flood (IRF)

The Intermediate Regional Flood is defined as one that could occur once in 100 years on the average, although it could occur in any year. It might be better described as a flood with a 1% chance of occurring each year. The limits on this flood are often used by Federal Agencies, states, cities and towns as minimum criteria in

establishing flood plain zoning in communities. Since there are no continuous records of discharges on the Saugus or Mill Rivers, the determination of the Intermediate Regional Flood was based on using developed peak discharge frequency data for the Aberjona River, a river containing similar characteristics to the Saugus and Mill rivers, and multiplying that data by the ratio of the net drainage areas to the .7 exponential power, and then adding the contributions from Lake Quannapowitt and Crystal Lake where appropriate.

Standard Project Flood (SPF)

The Standard Project Flood is defined as a major flood that can be expected to occur from a severe combination of meteorological conditions that is considered reasonably characteristic of the geographical area in which the study area is located, excluding extremely rare combinations. The Corps of Engineers in cooperation with the National Weather Service, has made comprehensive studies and investigations based on the past records of experienced storms and has developed generalized procedures for estimating the flood potential of streams. Peak discharges for the Standard Project Flood at selected locations in the study area are shown in Table 2. The Standard Project Flood is used by the Corps of Engineers in the design of local protection works. The Standard Project Flood (SPF) discharges used in this study are equal to 150 percent of the IRF. Such SPF estimates are not precise but are considered reasonable for use in Flood Plain information studies.

TABLE 2
PEAK FLOWS FOR INTERMEDIATE REGIONAL
AND STANDARD PROJECT FLOODS

| Location | Drainage Area (sq. mi.) Gross | Net | Peak Flows (cfs) IRF | SPF |
|---|---|---|---|---|
| Outlet-Lake Quannapowitt | 1.6 | - | 40 | 60 |
| Reading Drainage Canal | 3.2 | - | 330 | 500 |
| Saugus River Above Mill River | 12.1 | 10.5 | 700 | 1050 |
| Mill River at Mouth | 3.6 | 2.35 | 270 | 400 |
| Saugus River at Wakefield - Saugus Town Line | 15.7 | 12.85 | 870 | 1300 |

The Intermediate Regional and Standard Project Floods as outlined above are based on study and analysis of topography, precipitation, run-off, time of concentration and other relevant hydrological factors. This also takes into account the expected run-off rates from areas under reasonable future levels of development.

These studies, however, cannot predict the effect of the changes brought about by the human element in the development of the area. Continued encroachment on natural storage areas will

decrease temporary ponding space and increase the flood stages and flood discharges. Extraordinary development will result in unpredictable run-off rates. These factors could not be included in this study, but their effect may be considerable in the future.

Frequency

A frequency curve of peak flows was constructed on the basis of available information and computed flows of floods up to the magnitude of the Standard Project Flood. The frequency curve thus derived, which is available upon request, reflects the judgement of engineers who have studied the area and are familiar with the region. However, it must be regarded as approximate and should be used with caution in connection with any planning of flood plain use. Floods larger than the Standard Project Flood are possible, but the combinations of factors necessary to produce such large flows would be extremely rare.

Hazards of Large Floods

The extent of damage caused by any flood depends on the topography of the area flooded, depth and duration of flooding, velocity of flow, rate of rise and the nature and extent of developments in the flood plain. An Intermediate Regional Flood or Standard Project Flood on the Saugus and Mill Rivers would result in inundation of residential, commercial and industrial areas in the Town of Wakefield. Deep floodwater flowing at high velocity

and carrying floating debris would create conditions hazardous to persons and vehicles attempting to cross flooded areas. In general, floodwater three or more feet deep and flowing at a velocity of three or more feet per second could easily sweep an adult person off his feet, thus creating definite danger of injury or drowning. Rapidly rising and swiftly flowing floodwater may trap persons in homes that are ultimately destroyed, or in vehicles that are ultimately submerged or floated. Water supply pipe lines can be ruptured by deposits of debris and the force of floodwaters, thus creating the possibility of contaminated domestic water supplies. Damaged sanitary sewer lines and sewage treatment plants could result in the pollution of floodwaters, creating health hazards. Isolation of areas by floodwater could create hazards in terms of medical, fire or law-enforcement emergencies.

Flooded areas and flood damages - the areas that would be flooded by the Intermediate Regional and Standard Project Floods are shown in detail on Plates 3, 4 and 6. As may be seen from these plates, floodflows from the Saugus and Mill Rivers and their tributaries would cover large portions of the Town of Wakefield. The actual limits of these overflow areas may vary somewhat from those shown on the maps because the 10-foot contour interval and scale of the maps do not permit precise plotting of the flooded area boundaries. If an individual or a developer requires more accurate information, it will be necessary to obtain a detailed topographic survey at a larger scale and with contours at 1- or 2- foot intervals.

The areas that would be flooded by the Intermediate Regional and Standard Project Floods include commercial, industrial and residential sections and the associated streets, roads, and private utilities in the Town of Wakefield. Although some of the buildings are constructed above the flood level, access to them may be impossible due to the flooded roads in the area.

Obstructions - During floods, debris collecting on bridges and culverts could decrease their carrying capacity and cause greater water depths (backwater effect) upstream of these structures. Since the occurrence and amount of debris are indeterminate factors, only the physical characteristics of the structures were considered in preparing profiles of Intermediate Regional and Standard Project Floods. Similarly, the maps of flooded areas do not reflect increased water surface elevations that could be caused by debris collecting against the structures, or by deposition of silt in the stream channel under structures. Of the bridges in the study area, few would not cause obstructions to the Intermediate Regional and Standard Project Floods. Tables 3 and 4 list water surface elevations at bridges crossing the Saugus and Mill Rivers in Wakefield, Massachusetts.

TABLE 3
ELEVATION DATA
BRIDGES (CULVERTS) ACROSS THE MILL RIVER

| Identification | River Mile | Under-clearance Elevation | Water Surface Elevation Intermediate Regional Flood | Standard Project Flood |
|---|---|---|---|---|
| | | Ft./msl | Ft./msl | Ft./msl |
| Wiley Street | 0.26 | 53.9 | 58.0 | 59.5 |
| Farm Street | 0.49 | 54.7 | 58.1 | 59.5 |
| Vinton Street | 1.15 | 55.4 | 58.2 | 59.6 |
| Water Street | 1.22 | 57.0 | 58.4 | 59.6 |
| New Salem Street | 1.56 | 54.5 | 58.4 | 59.6 |
| Salem Street | 1.89 | 58.2 | 60.1 | 61.9 |
| Boston-Maine R.R. | 1.91 | 59.5 | 60.3 | 61.9 |
| Lowell Street | 2.21 | 65.5 | 64.6 | 65.0 |

TABLE 4
ELEVATION DATA
BRIDGES (CULVERTS) ACROSS THE SAUGUS RIVER

| Identification | River Mile | Under-clearance Elevation | Water Surface Elevation Intermediate Regional Flood | Standard Project Flood |
|---|---|---|---|---|
| | | Ft./msl | Ft./msl | Ft./msl |
| Water Street | 0.20 | 52.0 | 57.0 | 59.0 |
| Lowell Street | 1.54 | 65.0 | 66.6 | 69.0 |
| Route 128 | 1.64 | 79.5 | 68.0 | 69.3 |
| Saugus River Dam | 1.72 | - | 74.5 | 74.9 |
| Colonial Cntry Club | 1.74 | 72.2 | 75.2 | 76.0 |
| Boston-Maine R.R. | 3.70 | 72.5 | 75.6 | 76.4 |
| Route 128 | 3.93 | 78.5 | 76.9 | 78.5 |
| Route 128 Ramp | 4.08 | 80.8 | 77.3 | 78.9 |
| Vernon Street | 4.16 | 80.0 | 77.7 | 79.1 |
| Lowell Street | 4.79 | 82.3 | 80.5 | 82.3 |

Velocities of flow - Water velocities during floods depend largely on the size and shape of the cross-sections, conditions of the streams and the bed slope, all of which vary on different streams and at different locations on the same stream. On the Saugus and Mill Rivers during an Intermediate Regional or Standard Project Flood, the velocities would be 0.5 to 4 feet

per second. In localized reaches with steep slopes and narrow channels, the velocities would be greater. As much of the flood plain is wooded, or swampy with low-lying brush, overbank velocities would seldom exceed one foot per second, except in the developed areas of town. Water flowing at 2 feet per second or less would deposit debris and silt.

Rates of rise and duration of flooding - The more critical floods, which can occur in any month of the year, develop from rainfall and depend upon the intensity of the rainfall. This is sometimes enhanced by melting snow. Due to the lack of records of the past floods, the rates of rise and duration of flooding are not known in definite terms.

Photographs, future flood heights - The levels that the Intermediate Regional and Standard Project Floods are expected to reach at various locations in Wakefield are indicated in the photographs, Fig. 11 through 20.

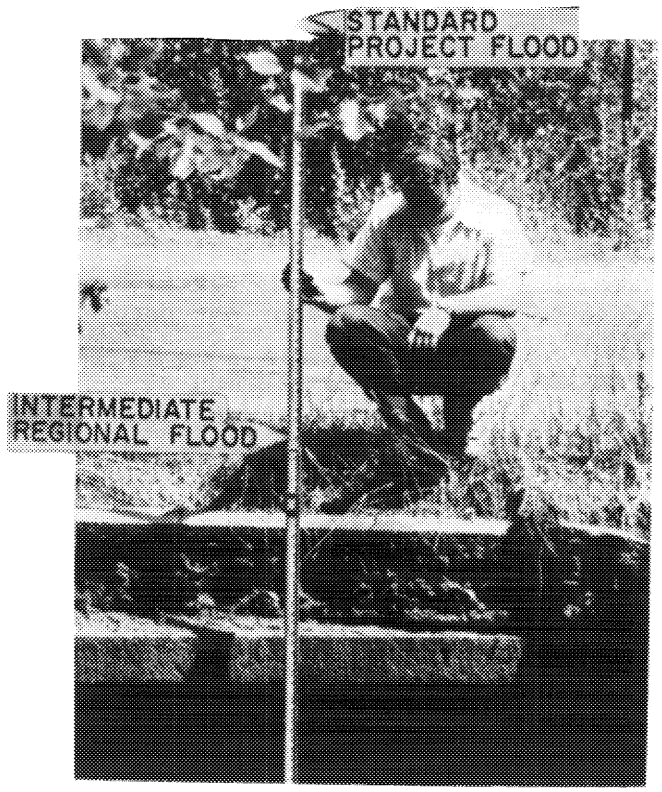



FIGURE 11 - FUTURE HEIGHTS AT WATER STREET BRIDGE - SAUGUS RIVER
RIVER MILE 0.20

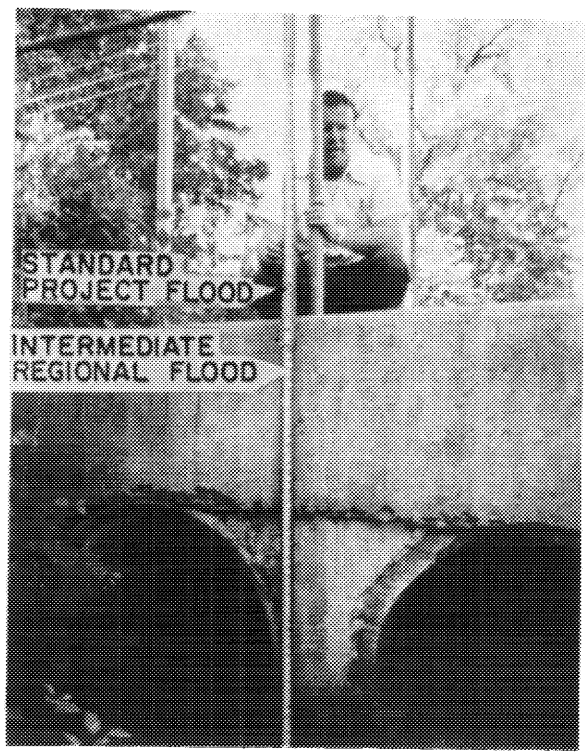



FIGURE 12 - FUTURE FLOOD HEIGHTS AT LOWELL STREET BRIDGE - SAUGUS RIVER
RIVER MILE 1.54

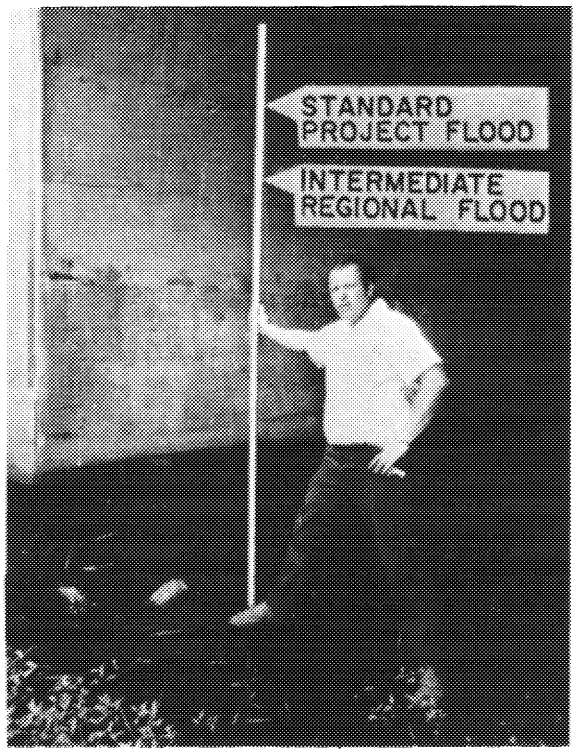



FIGURE 13 - FUTURE FLOOD HEIGHTS AT RTE. 128 BRIDGE DOWNSTREAM FROM SAUGUS RIVER DAM - SAUGUS RIVER - RIVER MILE 1.63

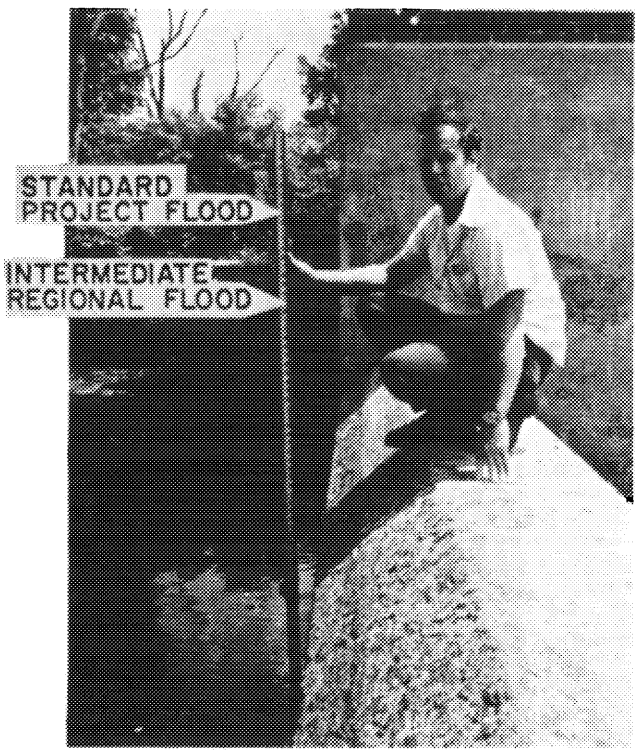



FIGURE 14 - FUTURE FLOOD HEIGHTS AT SAUGUS RIVER DAM - SAUGUS RIVER RIVER MILE 1.71

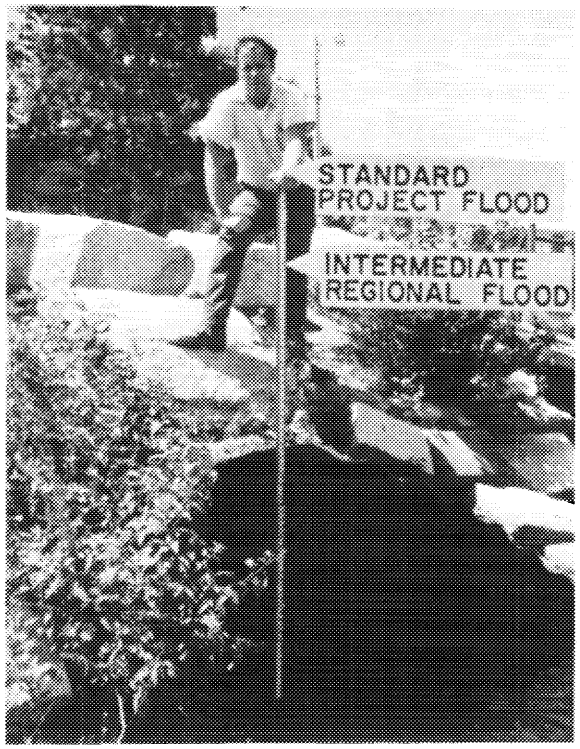



FIGURE 15 - FUTURE FLOOD HEIGHTS AT COLONIAL COUNTRY CLUB CULVERTS - SAUGUS RIVER
RIVER MILE 1.74


FIGURE 16 - FUTURE FLOOD HEIGHTS AT RTE. 128 BRIDGE DOWNSTREAM
FROM VERNON STREET - SAUGUS RIVER - RIVER MILE 3.93

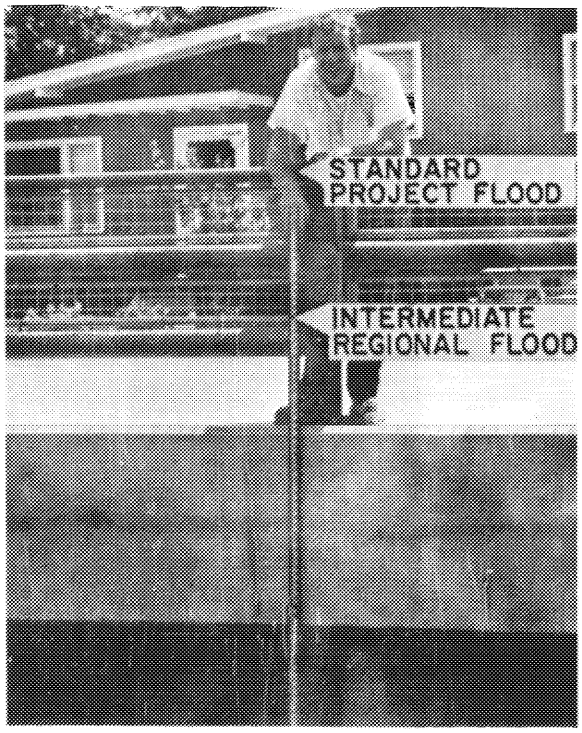



FIGURE 17 - FUTURE FLOOD HEIGHTS AT WILEY STREET BRIDGE - MILL RIVER
RIVER MILE 0.26


FIGURE 18 - FUTURE HEIGHTS AT FARM STREET BRIDGE - MILL RIVER
RIVER MILE 0.49

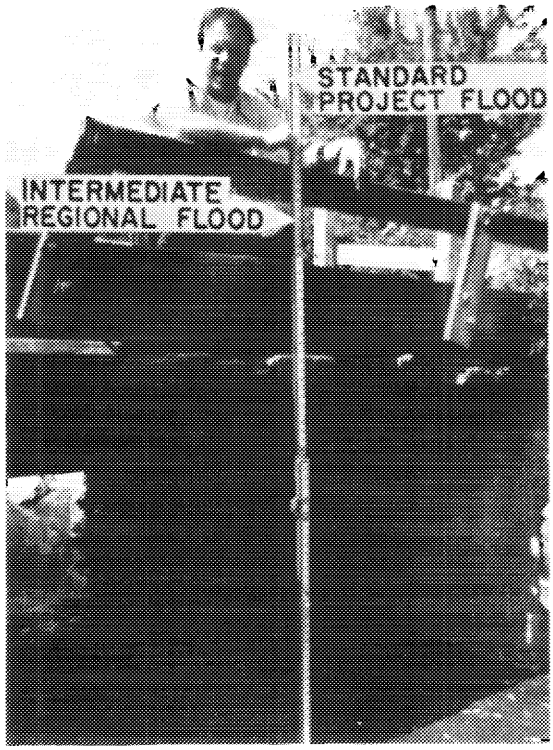



FIGURE 19 - FUTURE FLOOD HEIGHTS AT VINTON STREET BRIDGE - MILL RIVER
RIVER MILE 1.15

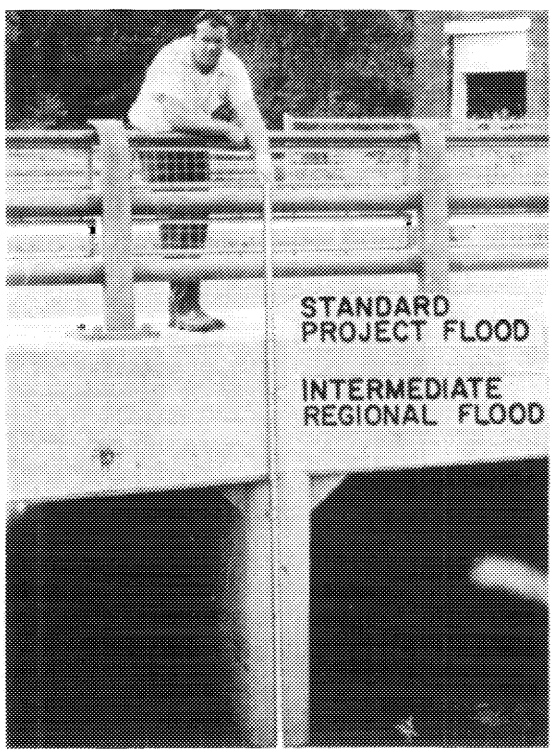



FIGURE 20 - FUTURE FLOOD HEIGHTS AT WATER STREET BRIDGE - MILL RIVER
RIVER MILE 1.22

# GLOSSARY

Backwater. The resulting high water surface in a given stream due to a downstream obstruction or high stages in an intersecting stream.

Flood. An overflow of water onto lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river or stream or an ocean, lake, or other body of standing water.

Normally, a "flood" is considered as any temporary rise in streamflow or stage, but not the ponding of surface water that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased streamflow, and other problems.

Flood Crest. The maximum stage or elevation reached by the waters of a flood at a given location.

Flood Hydrograph. A graph showing the stage in feet against time at a given point and the rate of rise and duration above flood stage.

Flood Plain. The areas adjoining a river, stream, watercourse, ocean, lake, or other body of standing water, which has been or may be covered by floodwater.

Flood Profile. A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage. The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

Hurricane. An intense cyclonic windstorm of tropical origin in which winds tend to spiral inward in a counterclockwise direction toward a core of low pressure with maximum surface wind velocities that equal or exceed 75 miles per hour (65 knots) for several minutes or longer at some points. Tropical storm is the term applied if maximum winds are less than 75 miles per hour.

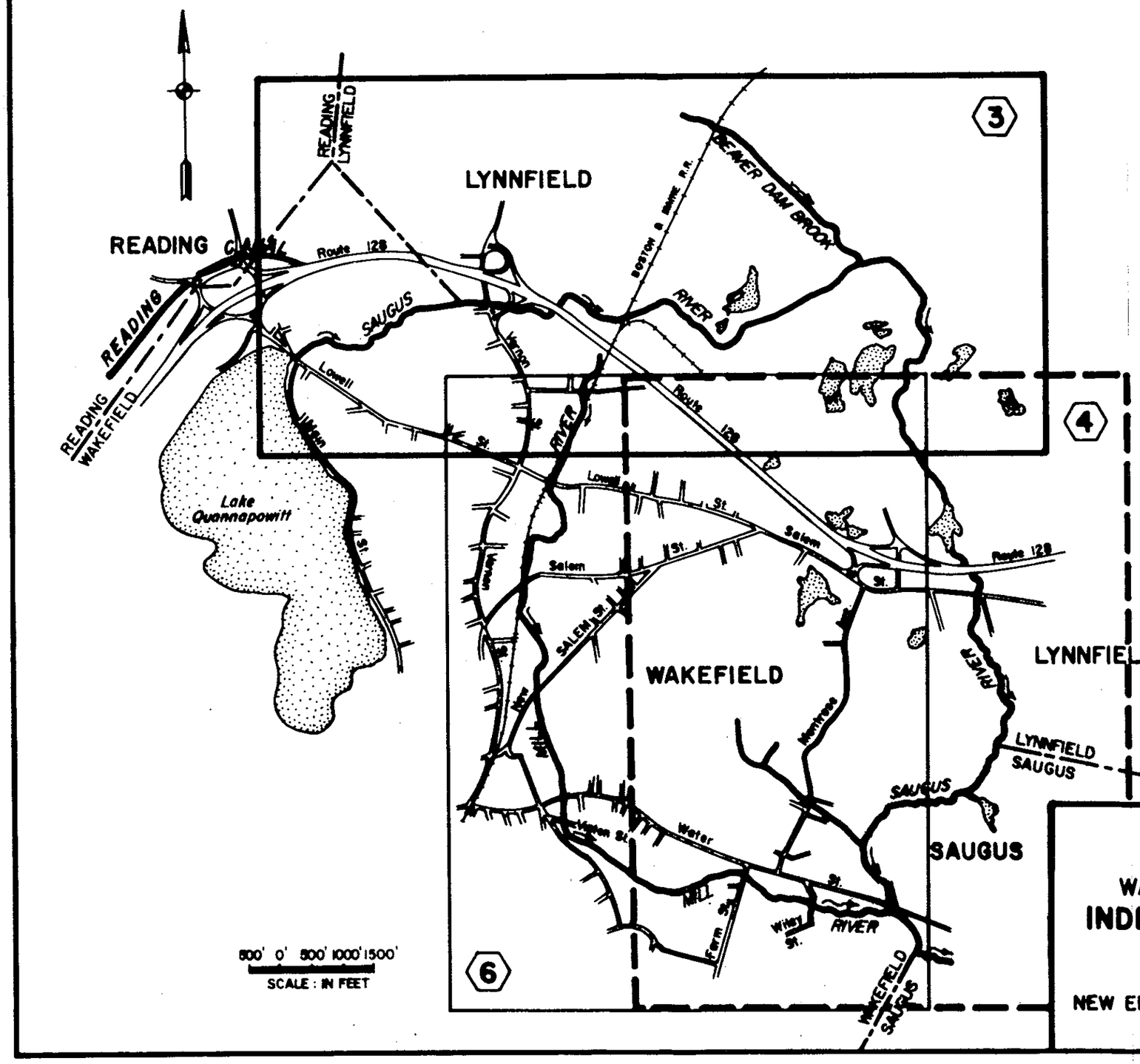
Intermediate Regional Flood. A flood having an average frequency of occurrence in the order of once in 100 years although the flood may occur in any year. It is based on statistical analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the "general region of the watershed".

Left Bank. The bank on the left side of a river, stream or watercourse looking downstream.

Right Bank. The bank on the right side of a river, stream or watercourse looking downstream.

Standard Project Flood. The flood that may be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations. Such floods, as used by the Corps of Engineers, are intended as practicable expressions of the degree of protection that should be sought in the design of flood control works, the failure of which might be disastrous.

Underclearance Elevation. The elevation at the top of the opening of a culvert or other structure through which water may flow along a watercourse. This is referred to as "low steel" in some regions.




## LEGEND

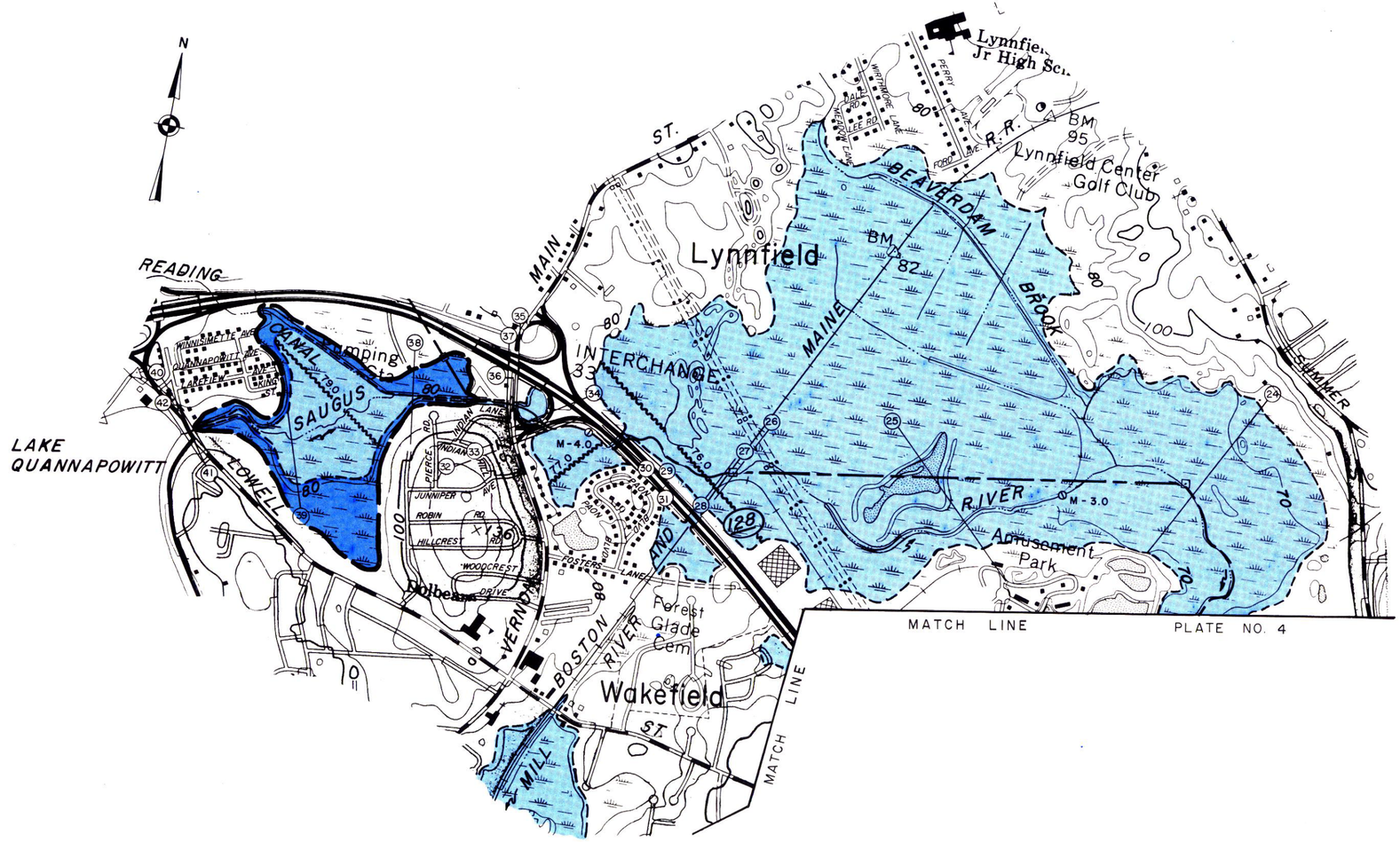
3 Plate Number

# FLOOD PLAIN INFORMATION
# SAUGUS AND MILL RIVERS
# WAKEFIELD, MASSACHUSETTS
# INDEX MAP - FLOODED AREAS

AUGUST, 1975

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

PLATE 2




## LEGEND

OVERFLOW LIMITS

- INTERMEDIATE REGIONAL FLOOD
- STANDARD PROJECT FLOOD
- M-3.0 — RIVER MILES ABOVE SAUGUS-WAKEFIELD TOWNLINE
- TOWN LIMITS
- 100 — GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL DATUM.
- 76.0 — INTERMEDIATE REGIONAL FLOOD - ELEVATION LINE
- (26) — CROSS SECTION
- CHANNEL

NOTES:

1. MAP BASED ON U.S.G.S. QUADRANGLE SHEETS BOSTON NORTH, MASS. 1971 AND READING, MASS. 1966. MINOR ADDITIONS AND ADJUSTMENTS MADE BY CORPS OF ENGINEERS.
2. LIMITS OF OVERFLOW SHOWN MAY VARY FROM ACTUAL LOCATION ON GROUND AS EXPLAINED IN THE REPORT.
3. AREAS OUTSIDE THE FLOOD PLAIN MAY BE SUBJECT TO FLOODING FROM LOCAL RUNOFF.
4. MINIMUM CONTOUR INTERVAL IS 10 FEET.
5. FOR FLOOD PROFILES SEE PLATE NO. 5.
6. WHERE IRF LIMIT IS ONLY SHOWN, THE SPF LIMIT IS CONSIDERED TO BE APPROXIMATELY THE SAME.

SCALE IN FEET

0 1000 2000

# FLOOD PLAIN INFORMATION
# SAUGUS RIVER
# WAKEFIELD, MASSACHUSETTS

## FLOODED AREAS

AUGUST, 1975

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. 3


## LEGEND

OVERFLOW LIMITS

- INTERMEDIATE REGIONAL FLOOD
- CROSS SECTION
- M-2.0 — RIVER MILES ABOVE SAUGUS-WAKEFIELD TOWNLINE
- TOWN LIMITS
- 100 — GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL DATUM.
- 57.0 — INTERMEDIATE REGIONAL FLOOD - ELEVATION LINE
- CHANNEL

NOTES:

1. MAP BASED ON U.S.G.S. QUADRANGLE SHEETS BOSTON NORTH, MASS. 1971 AND READING, MASS. 1966. MINOR ADDITION AND ADJUSTMENTS MADE BY CORPS OF ENGINEERS.
2. LIMITS OF OVERFLOW SHOWN MAY VARY FROM ACTUAL LOCATION ON GROUND AS EXPLAINED IN THE REPORT.
3. AREAS OUTSIDE THE FLOOD PLAIN MAY BE SUBJECT TO FLOODING FROM LOCAL RUNOFF.
4. MINIMUM CONTOUR INTERVAL IS 10 FEET.
5. FOR FLOOD PROFILES SEE PLATE NO. 5.
6. WHERE IRF LIMIT IS ONLY SHOWN, THE SPF LIMIT IS TO BE APPROXIMATELY THE SAME.

SCALE IN FEET

0 1000 2000

# FLOOD PLAIN INFORMATION

# SAUGUS RIVER

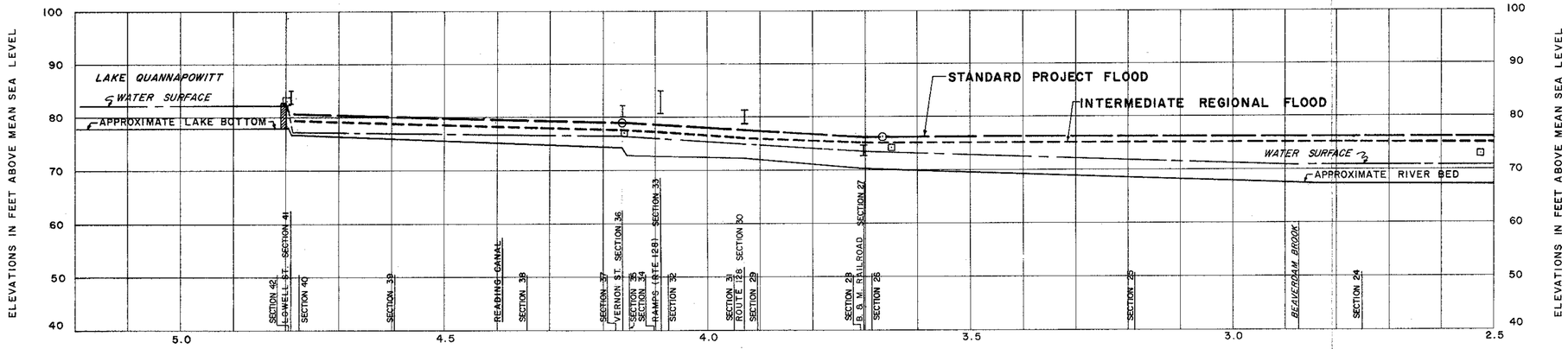
# WAKEFIELD, MASSACHUSETTS

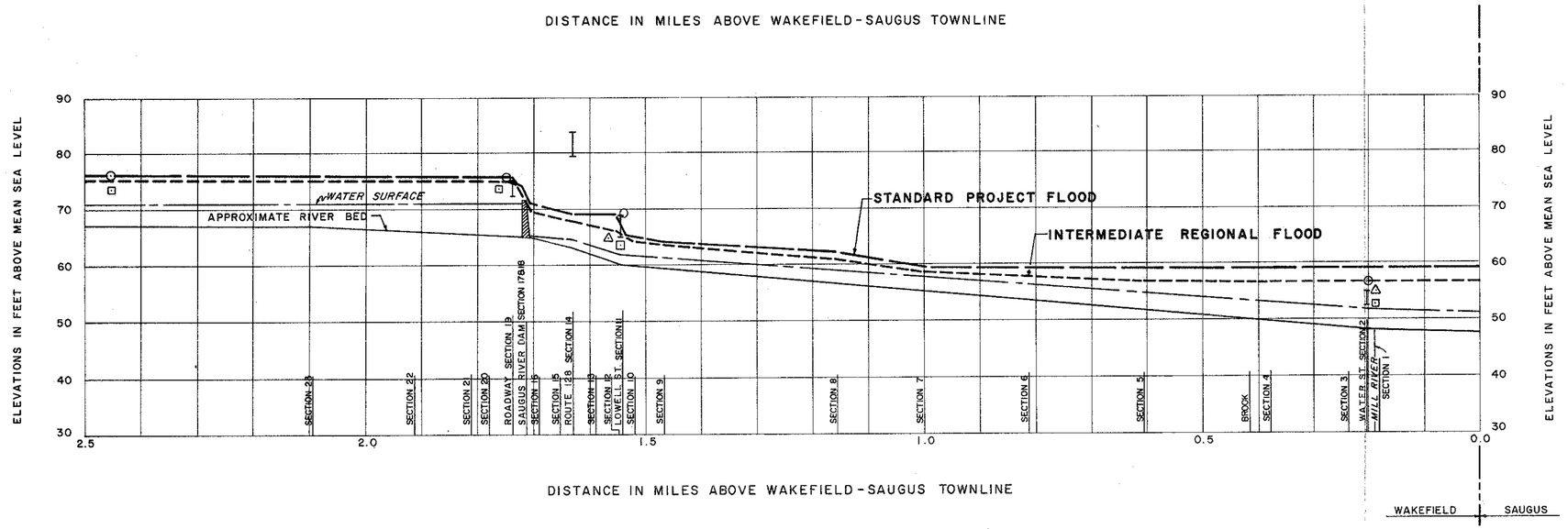
## FLOODED AREAS

AUGUST, 1975

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS

PLATE NO. 4




## LEGEND

I BRIDGE

DAM

HIGH WATER EXPERIENCED

- ⊡ MARCH 1936
- ⊙ OCTOBER 1962
- △ MARCH 1968

NOTES:

1. FOR PLANS SEE PLATE NO. S 3 AND 4.
2. ELEVATIONS FOR THE OCTOBER 1962 FLOOD PROFILE ARE APPROXIMATE. THEY WERE OBTAINED IN 1967 BY INTERVIEWING LOCAL RESIDENTS, TOWN AUTHORITIES AND PERSONS AT BUSINESS ESTABLISHMENTS.
3. ELEVATIONS FOR THE MARCH 1936 AND MARCH 1968 FLOOD PROFILES WERE OBTAINED BY FIELD SURVEY OF ESTABLISHED HIGH WATER MARKS.

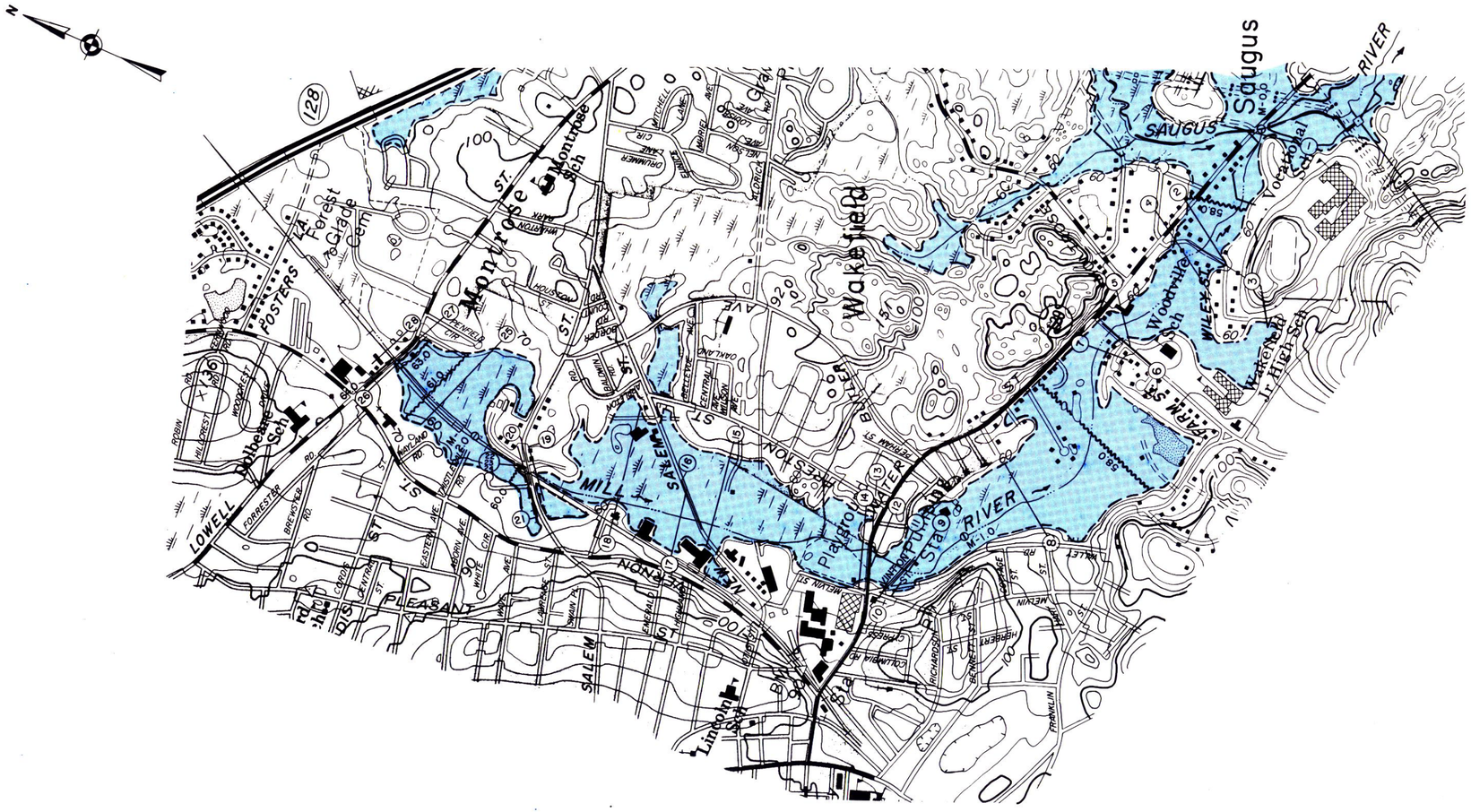
# FLOOD PLAIN INFORMATION
# SAUGUS RIVER
# WAKEFIELD, MASSACHUSETTS

## HIGH WATER PROFILES

AUGUST 1975

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. 5




## LEGEND

OVERFLOW LIMITS

- INTERMEDIATE REGIONAL FLOOD
- CHANNEL
- (8) CROSS SECTION
- M-1.0 RIVER MILE ABOVE CONFLUENCE WITH SAUGUS RIVER
- TOWN LIMITS
- 100 GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL DATUM.
- 58.0 INTERMEDIATE REGIONAL FLOOD - ELEVATION LINE

NOTES:

1. MAP BASED ON U.S.G.S. QUADRANGLE SHEETS BOSTON NORTH, MASS. 1971 AND READING, MASS. 1966. MINOR ADDITIONS AND ADJUSTMENTS MADE BY CORPS OF ENGINEERS.
2. LIMITS OF OVERFLOW SHOWN MAY VARY FROM ACTUAL LOCATION ON GROUND AS EXPLAINED IN THE REPORT.
3. AREAS OUTSIDE THE FLOOD PLAIN MAY BE SUBJECT TO FLOODING FROM LOCAL RUNOFF.
4. MINIMUM CONTOUR INTERVAL IS 10 FEET.
5. FOR FLOOD PROFILES SEE PLATE NO. 7.
6. WHERE IRF LIMIT IS ONLY SHOWN, THE SPF LIMIT IS CONSIDERED TO BE APPROXIMATELY THE SAME.

SCALE IN FEET

0 1000 2000

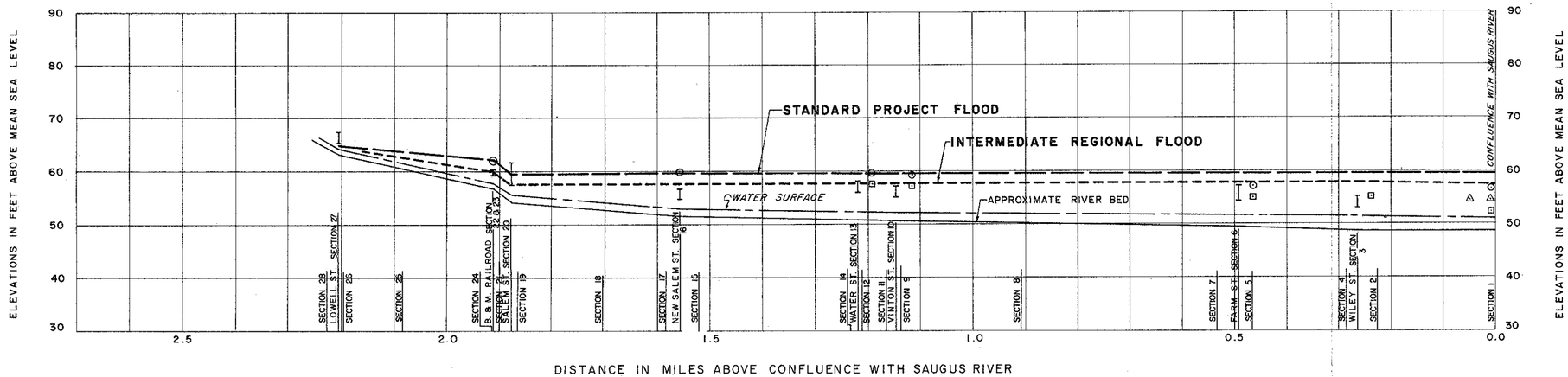
# FLOOD PLAIN INFORMATION
# MILL RIVER
# WAKEFIELD, MASSACHUSETTS

## FLOODED AREAS

AUGUST, 1975

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. 6




**LEGEND**

I BRIDGE

HIGH WATER EXPERIENCED

- ⊡ MARCH 1936
- ⊙ OCTOBER 1962
- △ MARCH 1968

NOTES:

1. FOR PLAN SEE PLATE NO. 6.
2. ELEVATIONS FOR THE OCTOBER 1962 FLOOD PROFILE WERE OBTAINED IN 1963 BY INTERVIEWING LOCAL RESIDENTS, TOWN AUTHORITIES AND PERSON AT BUSINESS ESTABLISHMENTS. IT IS CONSIDERED TO BE A FAIR APPROXIMATION.
3. ELEVATIONS FOR THE MARCH 1936 AND MARCH 1968 FLOOD PROFILES WERE OBTAINED BY FIELD SURVEY OF ESTABLISHED HIGH WATER MARKS.

# FLOOD PLAIN INFORMATION
# MILL RIVER
# WAKEFIELD, MASSACHUSETTS

## HIGH WATER PROFILE

AUGUST 1975

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE NO. 7